

# **The Dow Chemical Company's Approach to**

# **PSM / RMP Implementation**

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# Overview of Presentation

- High level overview of Dow's overall Process Risk Management Programs.
- How Dow utilizes globally standardized tools, work processes, and guidelines to provide a safe workplace around the globe.
- Approaches of a multi-national company in complying with US regulations and foreign regulations with similar programs.
- Q&A

# **Dow's Process Safety History**

**Dow has had a very strong history with Process Safety programs and requirements - prior to any regulatory requirements.**

- Pre-1960 - Fire Protection Engineering**
- 1963 - Corporate Safety & Loss Prevention Department formed**
- 1964 - Fire and Explosion Index (Risk Analysis)**
- 1966 - Reactive Chemicals Program**
- 1974 - Loss Prevention Principles issued**
- 1976 - Minimum Requirements (First Edition)**
- 1978 - Operations Practices (Minimum Requirements Emphasis)**
- 1982 - Fire Protection Practice Manual**
- 1986 - Chemical Exposure Index (CEI)**
- 1990 - Chemical Engineering Hazard Guidelines issued.**
- 1991 - Guidelines for Management of Change**
- 1994 - Process Risk Management Guidelines for Facilities and Distribution**
- 1994 - Guidelines for Hazard and Operability Study**
- 1997 - Process Safety Expertise Center established**
- 1997 - Global Reactive Chemicals Global Standard issued**
- 1998 - TDCC Business EH&S Risk Evaluation Work Process**
- 1999 - Global Mechanical Integrity Standard issued**
- 2000 - Introduction of Layers of Protection Analysis tool**

# Dow's Process Safety History

And our "history" never stops growing. We continuously improve upon our existing programs....

- Pre-1960 - Fire Protection Engineering
- 1963 - Corporate Safety & Loss Prevention Department formed
- 1964 - Fire and Explosion Index (Risk Analysis)
- 1966 - Reactive Chemicals Program

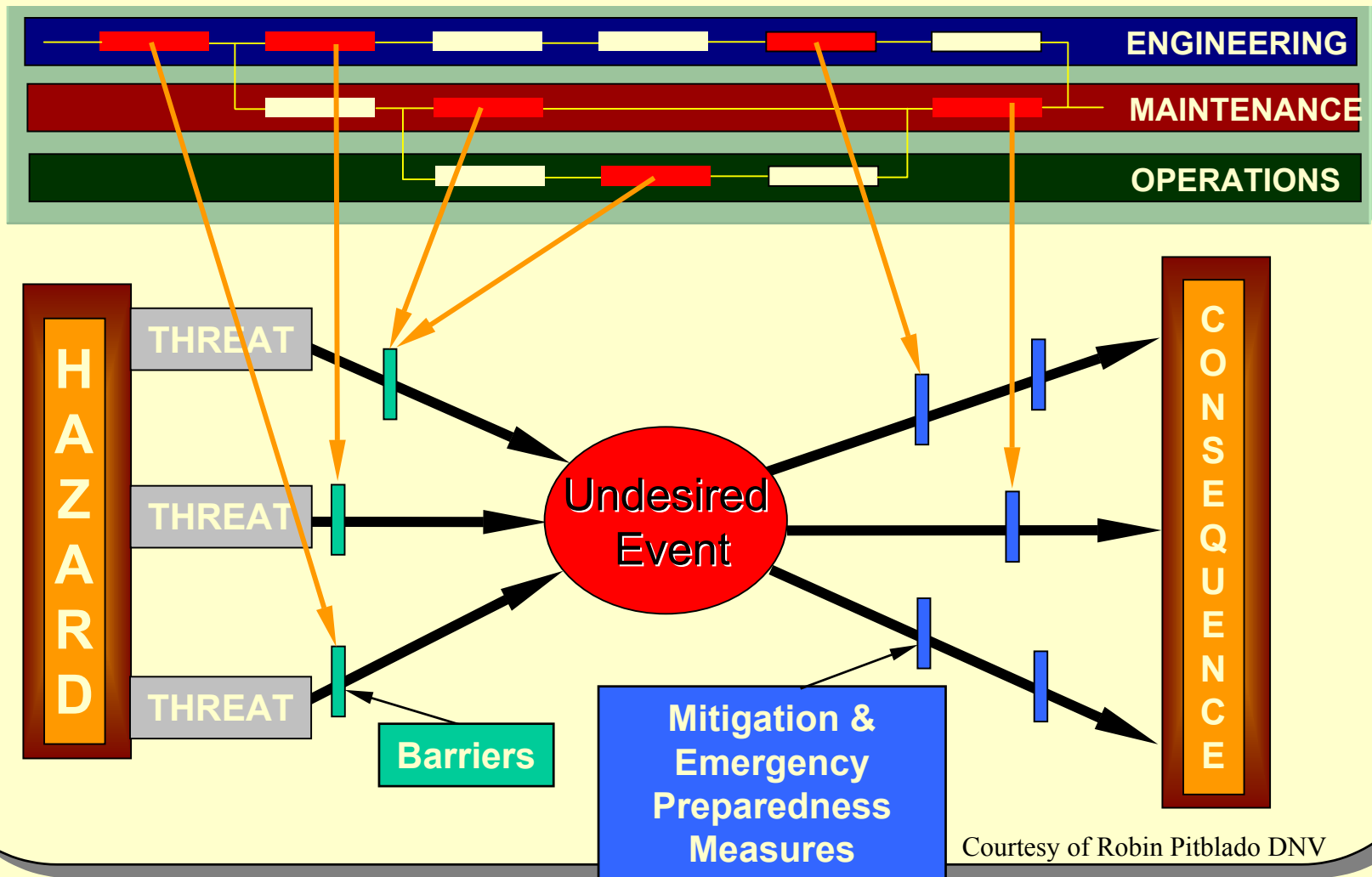
Although we already had a rich tradition in Process Safety, with the integration of best practices from UCC's Operational Safety program we've added to or enhanced several of our programs.

- 1997 - Process Safety Expertise Center established
- 1997 - Global Reactive Chemicals Global Standard issued
- 1998 - TDCC Business EH&S Risk Evaluation Work Process
- 1999 - Global Mechanical Integrity Standard issued
- 2000 - Introduction of Layers of Protection Analysis tool
- 2001 - *Enhanced Process Risk Management Program*
- *Building Overpressure Analysis*
- *Enhanced Layers of Protection Analysis*
- .... and many more.....

## **Implementation of OSHA PSM / EPA RMP Requirements**

- The majority of the OSHA PSM and EPA RMP requirements were satisfied with Dow's Process Safety, Training, Mechanical Integrity, and other programs which existed at the time.
- Compliance with PSM/RMP achieved primarily through new improved documentation and auditing requirements as documented in our Operating Discipline Management System (ODMS)
- Public communication of RMP summaries being achieved through extensions of our existing Community Awareness & Emergency Response Program and our Community Advisory Panels along with our on going work with the Local Emergency Planning Committees.

An effective Process Safety Management Program must address Hazard Elimination and Mitigation/Emergency Preparedness. It must also encompass the Design, Operation, and Maintenance of the facility



## Overview of the Dow Process Risk Management Program

### LEVEL 1: PROCESS HAZARDS ANALYSIS

- Triggers : All plants, significant projects and changes
- Fire & Explosion Index (FEI)
- Chemical Exposure Index (CEI)
- RC/PHA Questionnaire
- LOPA Target Factors\*

### LEVEL 2: RISK REVIEW

- Triggers: FEI>128, CEI>200, LOPA Target Factor  $\geq 7$  from Level 1
- Cause-Consequence pair Identification\*
- LOPA\* (Technologies new to Dow are HAZOP'd)
- Explosion Impact (Building Overpressure) evaluation\*
- Triggers: LOPA Target  $\geq 8$  or LOPA inappropriate.
- Structured Hazard Analysis

### LEVEL 3: ENHANCED RISK REVIEW

- Triggers: LOPA Protection Gap  $> 0$
- Dose-adjusted consequence analysis
- Screen for QRA\*

### LEVEL 4: QUANTITATIVE RISK ASSESSMENT

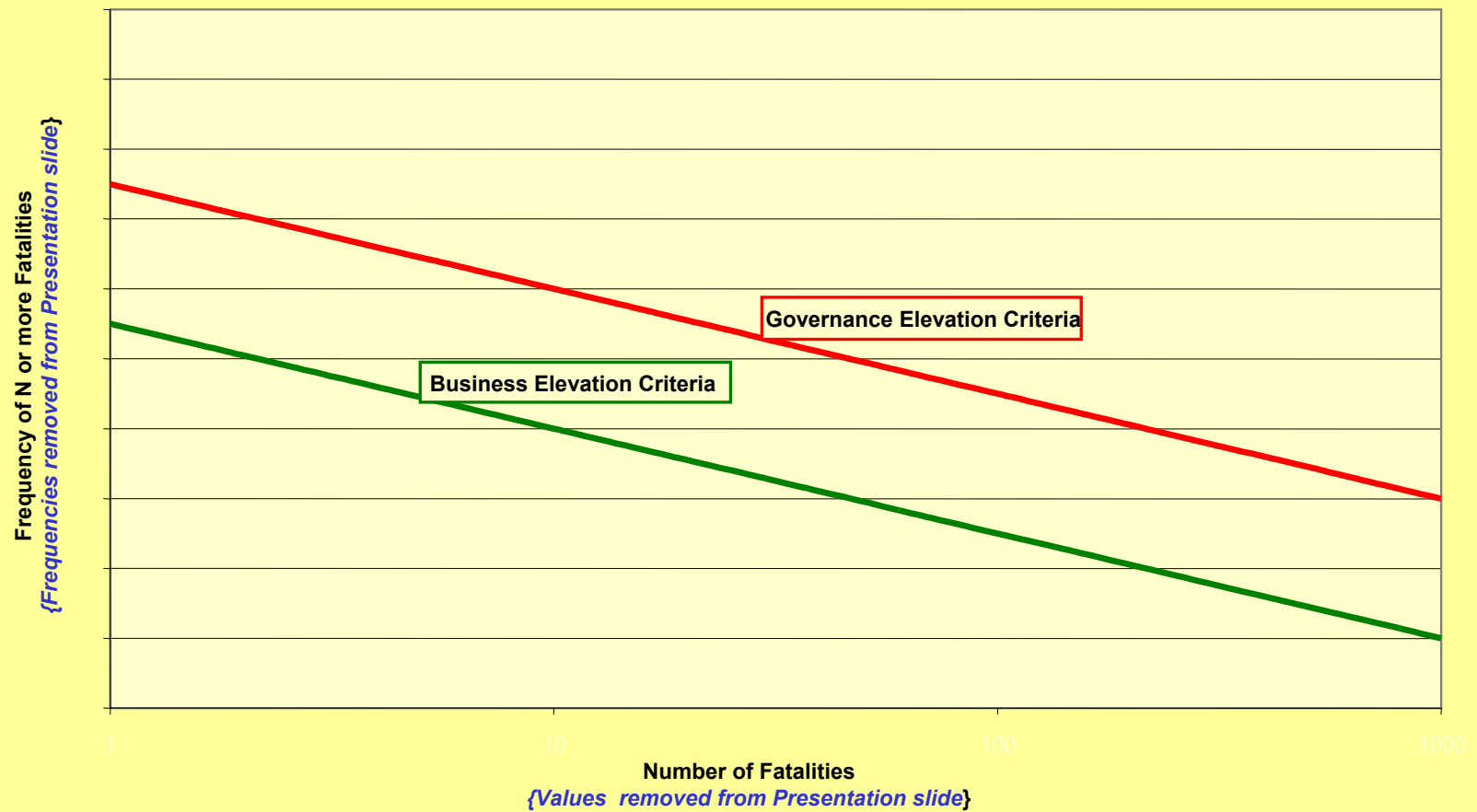
- Triggers: Individual Risk contours in off-site population exceeds Business Governance Elevation Criteria (as predicted by Level 3 Risk Review)
- Combination of Consequence Analysis, Frequency of Impact
- Focuses on highest risk activities

#### Business or Corporate Governance Approvals

- If Business Risk Elevation Criteria exceeded, review by full Business Leadership team required
- If Corporate Governance Risk Elevation Criteria exceeded, review by full Corporate EH&S Management Board is required.



**Off-Site Fixed Facility Risk Criteria for The Dow Chemical Company**





# Tools used to Facilitate PSM/RMP Implementation

- Global RC/PHA (Reactive Chemical / Process Hazard Analysis) Questionnaire spreadsheet

Microsoft Excel - RC PHA\_Jacarei 2001.xls

File Edit View Insert Format Tools Data Window Help RC/PHA

Times New Roman 10 B I U

G7

Facility: DITHANE PLANT  
Site: JACAREI  
Comp. by: YARDAN N COSTA. Revised by: Delário Gomes, Adriano Reis, Yardan Costa and João Carlos Gregoris ( Team Leader ).

Back to Main Menu

Date: November 12 and 13, 2001.  
Technology Center: Dow AgroSciences

**EXISTING FACILITY REVIEW**  
Use "X" to mark the answers

C#	Q#	QUESTION	Y E S	N O	RESPONSE (provide written response and include a copy or a path to the e-document if requested)	DISCIPLINE C P R L R C P	Action Items
A.		<b>General Information</b>				X X X X	
A.	1a	Are you current with your new production leader reactive chemicals review? When was the last review?	X		The plant elaborated the first Reactive Chemicals Manual on November,01 and schedule the RC/PHA production leader review to be held on November, 12-13 and 26-27.	X X	
A.	1b	Are you current with your periodic Reactive Chemicals/Process Hazard Analysis Review for Existing Facilities? When was the last review?	X		This is the first Review for DAS / R & H Jacarei ( November, 2001)	X X	
A.	1c	Has this facility completed a review for compliance with the Dow Loss Prevention Principles (LPPs) Mandatory Requirements? If so when?	X		A preliminary gap analysis was completed on November, 2001.	X X	- Get feedback / approval from the Tech C preliminary LPP Gap Analysis.
A.	1d	Is the facility in compliance with the LPP Mandatory requirements? If not what is the timing of the compliance plan?	X		The plant is elaborating an compliance plan to be finish in 2 years,according to the preliminary analysis to be done.	X X	- Implement the actions raised during the Analysis until November 2003, upon bus for the action plan.
A.	2a	Are process changes reviewed for reactive chemicals and process hazards before they are installed? Who reviews changes that might involve Reactive Chemicals issues?	X		All corrective actions resulted from the PHA review will be documented and followed-up throughout E&AT. Changes are already analysed as per MOC procedure.	X X	- Train reviewers / approvers and install t tool for MOC.
A.	2b	Are pre-startup reviews held for new projects and recommissioning equipment?	X			X	- Provide training for plant people on Dow Start-Up Procedure.
A.	3a	Do you use a documented management of change process? What protocol or tool is used for MOC?	X		The facility utilizes the MOC in paper, the procedure was elaborated and the plant operation was trained.	X	
A.	3b	Have there been process changes that could have a significant favorable or unfavorable impact on the process safety of the unit since the last review? (List or provide in Process Safety Section of Operating Discipline File and provide file location.)	X		Last significant changes were: natural gas replacing fuel oil on the spray drier, hot water replacing steam on the D-14 stripper for CS2 and on the slurry washing. Both were object of a safety analysis as per R & H procedure for management of change.		

Introduction & Protocol PHA Table of Contents & Key PHA Questionnaire Appendix A Appendix B1 and B2 Appendix C Facility Insurance Report Insurance

Filter Mode

- \* Over 500 questions
- \* Questions formatted to stimulate additional discussion and identify areas for improvement.
- \* Single questionnaire (but sorted for different questions) for new project reviews, PHAs, and New Leader reviews.
- \* Spreadsheet reused for PHA Revalidation

## Topics covered in Dow RC/PHA

### CATEGORY

- A. General Information
- B. Chemical Exposure Index (CEI)
- C. Fire & Explosion Index (F&EI)
- D. Higher Risk Reviews (HAZOPs and LOPA)
- E. Additional Risk Evaluation
- F. Reactive Chemicals Data
- G. Confirmation of Raw Materials
- H. Materials of Construction and Maintenance Materials
- I. Side Reactions and Reactive Conditions
- J. Catalyst/Initiators/Mole Sieves
- K. Inhibitors for Monomers and Reactive Materials
- L. Flammable Mixtures / Dusts / & Ignition Sources
- M. Control Systems / Computers
- N. Environmental Controls and Waste Handling
- O. Back-flow Devices / Emergency Flow Blocks
- P. Chemical Storage and Handling & Utilities
- Q. Plant Drainage
- R. Distribution Containers and Heels in Equipment
- S. Reactive Chemical Compatibility Chart
- T. Reactive Chemicals/Process Safety Training and Scenarios
  
- U. Customer Information
- V. Process Equipment Review
  - Exchangers
  - Agitators
  - Static Mixers
  - Scrubbers
  - Rotating Equipment
  - Fired Equipment inc. Hot Oil Systems and Flares
  - Distillation
  - Vessels and Piping
  - Relief Devices and Vent Systems

### CATEGORY

- W. Inherently Safe Design
- X. Human Design Factors and Personal Protection
- Y. Safe Plant Layout and Building Design
- Z. Electrical Classification and Safe Design

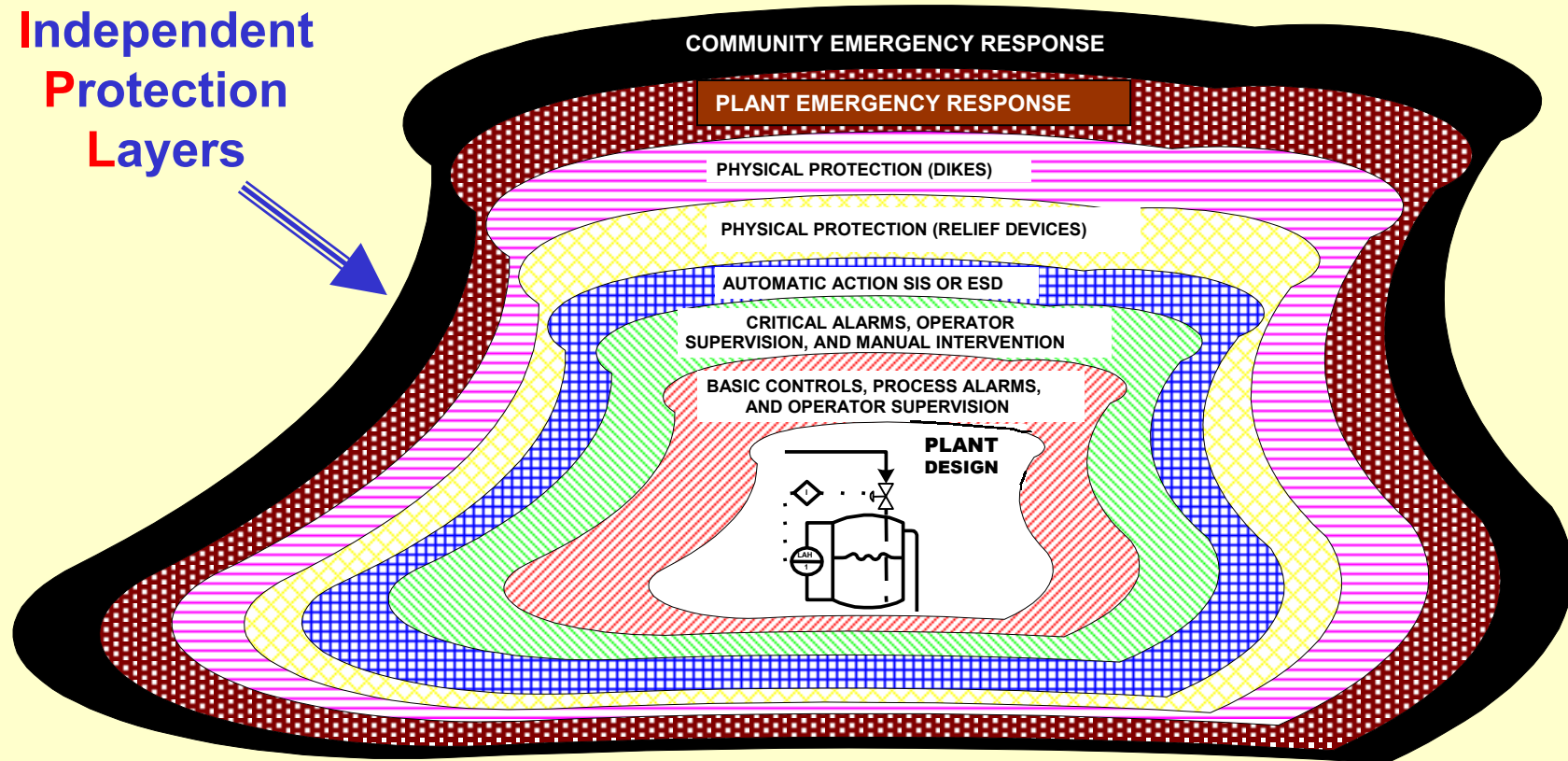
Appendix A – Reactive Chemicals/PHA Field Verification

Appendix B1 – U.S. Specific Requirements

Appendix B2 – Europe Specific Requirements

## Dow's other Broadly used Risk Review tool is a Layers of Protection Analysis (LOPA)

**Independent  
Protection  
Layers**



## **Corporate Work Processes, Guidelines, etc.**

- **Dow depends strongly upon the use of corporate-wide work processes and guidelines for implementation of Operating Discipline, Management of Change, Mechanical Integrity programs, Training, Project reviews, etc.**
- **Dow “Loss Prevention Principles” contains several hundred pages of best practices, recommendations, and mandatory requirements for Dow facilities based upon our experiences and beliefs on how to design a safer facility.**

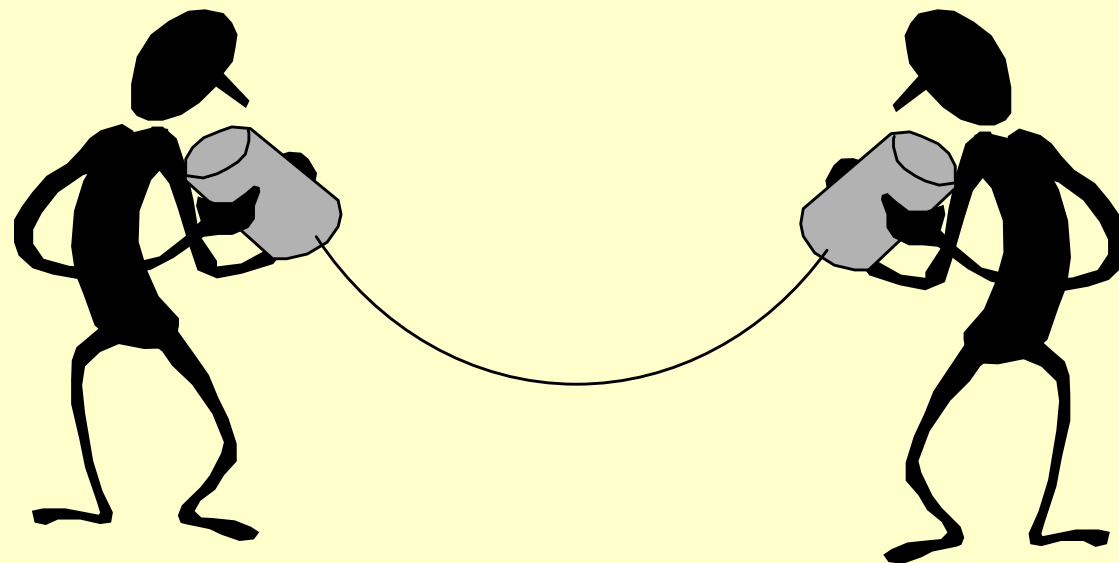
# Corporate Work Processes, Guidelines, etc.

## Table of Contents for Dow LPPs:

Topic	Topic	Topic
<b>PREFACE</b>	6.3 Tanks and Vessels	<b>11. COMBUSTIBLE DUSTS AND SOLIDS</b>
<b>TABLE OF CONTENTS</b>	6.4 Glass and Transparent Devices	11.1 Combustible Dusts
<b>1. INTRODUCTION</b>	6.5 Compressed Gas Cylinders	11.2 Foamed Plastics
1.1 Introduction to Loss Prevention Principles	6.6 Minimum Requirements for Fiber Reinforced Plastic Vessels	11.3 Foamed Plastic Insulation
1.2 Fire and Explosion Index	6.7 Metals, Alloys and Non-Metallic Materials of Construction	<b>12. BUILDINGS</b>
1.3 Chemical Exposure Index	6.8 Industrial Truck Classifications	12.1 Purged Control Rooms
1.4 Project Review Process	6.9 Use of Vacuum Trucks or Vacuum Equipment with Flammable, Combustible, or Reactive Materials	12.2 Occupied Plant Buildings Subject to External Hazards
1.5 Material Hazard Identification	<b>7. STORAGE AND HANDLING OF CHEMICALS AND UTILITIES</b>	12.3 Office Buildings
1.6 Loss Prevention Checklist	7.1 Flammable Liquids	12.4 Warehouse Buildings
1.7 Chemical Interactivity Charts	7.2 Liquefied Petroleum Gases	12.5 Laboratories
<b>2. PLANT LAYOUT</b>	7.3 Combustible Liquids	12.6 Laboratory Fume Hoods
2.1 Indoor Versus Outdoor Plant Operations	7.4 Unstable and Reactive Chemicals	12.7 Process Analyzer Outdoor Buildings/Enclosures
2.2 Layout and Separation of Facilities	7.5 Dikes and Containment	<b>13. FIRED EQUIPMENT</b>
2.3 Access Roadways	7.6 Storage Cabinets for Flammable Liquids and Combustible Liquids	13.1 Safety and Control of Fired Equipment
2.4 Sewer and Drain Systems	7.7 Inert Gases and Nitrogen Utility Systems	13.2 Heat Exchange Systems
<b>3. ELECTRICAL</b>	7.8 Utility Air Systems Including Breathing Air	13.3 Outdoor Oil Fired Boilers
3.1 Electrical Area Classifications	7.9 Potable Water Systems	13.4 Furnaces Heating Flammable Materials
3.2 Cable Tray Location and Protection	7.10 Utility Water Systems (Excluding Potable Water)	<b>14. RELIEF AND VENT SYSTEMS</b>
3.3 Lighting	7.11 Utility Steam and Condensate Systems	14.1 Pressure/Vacuum Relief Systems
3.4 Process Plant Power Systems	7.12 Utility Natural Gas Systems	14.2 Flare Systems
3.5 Motor Control Centers and Electrical Rooms	<b>8. LOADING AND UNLOADING STATIONS</b>	14.3 Flame Arresters and Detonation Arresters
3.6 Static Electricity	8.1 Tank Cars and Tank Trucks	<b>15. INSTRUMENT AND COMPUTER CONTROL</b>
3.7 Mineral Oil Filled Power Transformers	8.2 Ships and Barges	15.1 Instrument Installation
3.8 Electrical Maintenance – Predictive/Preventive Maintenance	<b>9. DETECTION SYSTEMS</b>	15.2 Emergency Shutdown
<b>4. FIRE WATER SYSTEMS</b>	9.1 Fire Detectors	15.3 Process Control Computer and Business Mini-Computer Safeguards
4.1 Fire Water Pump and Driver	9.2 Combustible Gas Detectors	15.4 Safety Instrumented Systems
4.2 Sprinkler Drain Test	<b>10. FIRE DAMAGE CONTROL SYSTEMS</b>	<b>16. ROTATING PROCESS EQUIPMENT</b>
4.3 Water Mains and Layout	10.1 Preamble to Fire Damage Control Systems	16.1 Critical Rotating Equipment
4.4 Basic Hydraulics	10.2 Use of Inert Gas for Padding (DELETED)	16.2 Safe Operation of Gas Turbines
4.5 Fire Water Source	10.3 Wet and Dry Pipe Sprinkler Systems	16.3 Steam Turbine Generators
4.6 Fire Water Demand	10.4 Deluge Systems	16.4 Deadheaded Pumps
<b>5. FOAM SYSTEMS</b>	10.5 Carbon Dioxide Systems	<b>17. PIPING</b>
5.1 Foam Protection Applications	10.6 Dry Chemical Systems	17.1 Introduction and Scope
5.2 Foam Protection for Tanks	10.7 The Use of Halon	17.2 Definitions and Abbreviations
5.3 Types of Foams	10.8 Fireproofing	17.3 Codes and References
5.4 High Expansion Foams	10.9 Water Curtains	17.4 Piping Materials
5.5 Foam Proportioning Systems	10.10 Insulation for Fire Protection	17.5 Piping Material Specifications
5.6 Maintaining Foam Systems	10.11 Inspection, Testing and Maintenance of Fire Protection Systems	17.6 Piping Design
<b>6. EQUIPMENT</b>	10.12 Explosion Suppression	17.7 Piping Fabrication
6.1 Cooling Towers	10.13 Fire Doors	17.8 Piping Installation
6.2 Air-Cooled Heat Exchangers		17.9 Piping Operation and Maintenance
		17.10 Utility Piping (DELETED)
		17.11 Potable Water and Breathing Air (DELETED)



# And Now It's Your Turn...



**Questions??**

**Thank You**